



Iowa Department of Transportation

DEVELOPMENTAL SPECIFICATIONS FOR TRENCHLESS CONSTRUCTION

Effective Date
January 19, 2005

THE STANDARD SPECIFICATIONS, SERIES 2001, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE DEVELOPMENTAL SPECIFICATIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

Replace Section 2418 of the Standard Specifications with the following:

Section 2418. Trenchless Construction.

2418.01 DESCRIPTION

This work involves the installation of pipe that is forced through existing embankment from side to side by application of force. Installation of pipe may be by one of the following methods unless otherwise indicated in the contract documents:

- A. Auger Boring: A boring method that utilizes a rotating cutting head to form the bore and a series of rotating augers inside a casing pipe to remove the spoil.
- B. Compaction Method: Boring methods that displace soil radially rather than removing spoil. Bore hole may be formed with a push rod or impact mole.
- C. Directional Drilling: A boring method for installing pipe from a surface launched drilling rig. A pilot bore is formed and then enlarged by back reaming. The pipe is then pulled in.
- D. Pipe Ramming: A boring method that involves driving a steel casing pipe with a percussive hammer. The front end of the casing pipe may be open ended or closed. If open, spoil must be removed from the pipe.
- E. Slurry Boring: A boring method which first forms a pilot bore by forcing a drill tube through the embankment. The pilot hole is then enlarged by reaming. As the hole is enlarged with the reamer, drilling fluid (slurry) is pumped into the hole to hold the soil cuttings in suspension. After reaming, the pipe is pulled into place.
- F. Microtunneling: A boring method that consists of a remotely controlled pipe jacking operation utilizing a tunnel boring machine. Personnel entry is not required.

G. Pipe Jacking: A jacking method in which pipe is pushed into the ground with hydraulic rams while soil is simultaneously excavated. Excavation is normally completed with a tunnel boring machine. This method requires personnel to enter the tunnel during the excavation process.

H. Utility Tunneling: A method of forming large diameter tunnels. As excavation takes place at the front of the tunnel, a liner is constructed to temporarily support the tunnel. Upon completion of the tunnel the pipe is pushed in place.

I. Other methods not described here may be allowed upon approval of the Engineer.

2418.02 MATERIALS.

A. Concrete Pipe: Concrete pipe for culverts or casing to be installed by trenchless methods shall meet requirements of Section 4145 for the type specified and the following requirements:

Pipe may be furnished as a single unit or sectional. If sectional, it shall have joints of a type that will assure positive engagement of the sections during and after placement. Square end pipe without proper connecting devices will not be permitted. Pipe having projections on exterior surfaces that requires an excavation larger than the body of the pipe will not be permitted.

B. Steel Pipe: Steel pipe for culverts or casing shall be new and meet the requirements of ASTM A 139, Grade B; ASTM A 252, Grade 2; or ASTM A 53, Grade B. Hydrostatic test should be waived for non-pressure applications and can be designated as (no hydro).

Joints shall comply with American Welding Society Code. Fully weld all joints with full penetrating weld, including joints of casing pipes laid in open pipe trenches.

Upon approval of the Engineer, connecting adjacent pieces of steel pipe during installation may be achieved by a CNC machined integral press fit connection such as Permalok, or approved equal, as long as loading and installation design criteria are met. The press fit connection of the pipe shall be installed in accordance with the pipe manufacturer's recommendation.

Casing Pipe Minimum Wall Thickness:

NOMINAL DIAMETER INCHES (mm)	WALL THICKNESS, MINIMUM INCHES (mm)	
	UNDER HIGHWAY	UNDER RAILROAD
6 thru 14 (150 thru	0.188 (4.78)	0.25000 (6.35)
16 (465)	0.188 (4.78)	0.28125 (7.14)
18 (450)	0.25 (6.35)	0.31250 (7.94)
20 (510)	0.25 (6.35)	0.34375 (8.73)
22 (560)	0.25 (6.35)	0.34375 (8.73)
24 (600)	0.281 (7.14)	0.37500 (9.53)
26 (660)	0.281 (7.14)	0.40625 (10.32)
28 (710)	0.312 (7.92)	0.43750 (11.11)
30 (750)	0.312 (7.92)	0.46875 (11.91)
32 (815)	0.312 (7.92)	0.50000 (12.70)
34 (865)	0.312 (7.92)	0.53125 (13.49)
36 (900)	0.344 (8.74)	0.53125 (13.49)
38 (965)	0.344 (8.74)	0.56250 (14.29)

40 (1015)	0.344 (8.74)	0.59375 (15.08)
42 (1050)	0.344 (8.74)	0.62500 (15.88)
44 (1120)	0.344 (8.74)	0.65625 (16.67)
46 (1170)	0.344 (8.74)	0.65625 (16.67)
48 (1200)	0.344 (8.74)	0.68750 (17.46)
50 (1270)	For sizes greater than 48 inch (1200 mm) diameter, consult the Engineer	0.71875 (18.26)
52 (1320)		0.75000 (19.05)
54 (1370)		0.78125 (19.84)
56 (1420)		0.81250 (20.64)
58 (1470)		0.81250 (20.64)
60 (1525)		0.84375 (21.43)
62 (1575)		0.87500 (22.23)
64 (1625)		0.90625 (23.02)
66 (1675)		0.93750 (23.81)
68 (1725)		0.93750 (23.81)
70 (1780)		0.96875 (24.61)
72 (1830)		1.00000 (25.40)

C. Casing Pipe Diameter: Minimum inside diameter as shown in the contract documents. If not shown, casing diameter shall not be less than 4 inches (100 mm) greater than the greatest outside diameter of the carrier pipe, including pipe bells.

D. Casing Pipe Filler

A. The space between the carrier pipe and casing pipe shall not be filled unless required by the contract documents. The space shall not be completely filled to avoid transfer of earth and live loads from the casing to the carrier pipe.

B. Fill material: Fill sand or flowable mortar.

E. Carrier Pipe Guide

1. Manufactured guide to position carried pipe in casing. Wood skids will not be allowed.

2. Material requirements for carrier pipe guide shall be in accordance with the following:

a. Band/Panel: ASTM A 240, Type 304 stainless steel or ASTM A 36 for carbon steel.

b. Riser: ASTM A 240, Type 304 stainless steel or ASTM A 36 for carbon steel.

c. Liner: Elastomeric PVC per ASTM D 149.

d. Chock Skid/Runner: Abrasion resistant polymer with a low coefficient of friction.

e. Fasteners: ASTM A 193 Type 304 (18-8) Stainless Steel.

2418.03 CONSTRUCTION.

Before installation begins, the pipe or initial section of pipe shall be aligned on a prolongation of the line and grade shown in the contract documents or staked by the Engineer, and shall be held by braces, guideways, and other devices, to follow these lines and grades as close as possible as it progresses through the embankment.

A. Pipe Installation.

1. Casing Pipe or Un-cased carrier pipe Installation:

- a. Install pipe by auger boring, pipe jacking, microtunneling, open-ended pipe ramming, directional drilling (back-reaming required), or utility tunneling.
- b. Methods which displace excess soil, rather than removing it, such as impact moling, push rod, or closed end pipe ramming will not be permitted.
- c. Water jetting will not be allowed.
- d. Use a jacking collar, timbers, and other means as necessary to protect the driven end of the pipe from damage.
- e. Fully support borehole at all times to prevent collapse. Insert pipe as earth is removed, or support bore with drilling fluid.
- f. Fill annular space between the inside of the bore hole and the outside of the pipe if the space is greater than 1 inch (25 mm) using flowable mortar.

2. Carrier Pipe Installation Through Casing:

- a. Clean dirt and debris from the casing pipe after installation.
- b. Attach pipe guides or casing chocks to pipe sections as necessary to support pipe barrel in accordance with pipe manufacturer's recommendation. Do not allow pipe to be supported by joint bells.
 1. Pipe guides: At least one per pipe section.
 2. Lubricant for pipe guides: Drilling mud or flax soap. Do not use petroleum-based lubricants or oils.
- c. Assure that thrust loads will not damage carrier pipe joints. Provide thrust collars between joint shoulders of concrete pipe.
- d. Provide timbers for sufficient cushioning between the end of the pipe pushed and the jacking equipment to prevent damage to the pipe. Do not allow steel jack face to thrust against unprotected pipe end.
- e. Position jacks so that resultant force is applied along the centerline of the pipe, and that force is applied evenly to the entire end of the pipe.
- f. Assemble pipe joints in the jacking pit before pushing the carrier pipe into the casing.
- g. Close end of casing pipe around the carrier pipe with open joint masonry plug.

Excavation for a limited distance ahead of the forward end of the pipe will be permitted when the soil is sufficiently stable to stand without danger of caving. In this case, the hole shall be trimmed to the outside diameter of the pipe to reduce resistance to jacking and to maintain contact between embankment material and outside surface of the pipe. In soft or unstable soil, the pipe shall be allowed to cut its way through the soil to avoid danger of caving and subsidence of the overlying embankment and roadway. If the pipe is of metal with a coating of corrosion resisting material, care shall be taken to protect the coating from damage during installation and excavating processes.

A small, high pressure, low volume water jet (4 gal/min maximum (15 L per minute maximum)) may be used to cut the soil within a steerable shield at the leading edge of the pipe being installed. The water and the operation shall be controlled so there is no change in the condition of the soil adjacent to the pipe and no flow of water along the outside of the pipe.

Obstructions to the progress of the pipe, such as roots, boulders, or parts of former structures, shall be removed. Deviations from line or grade to pass obstructions shall be avoided if such deviation will result in unsatisfactory fitting joints. The use of explosives for removing obstructions will not be allowed.

Provisions shall be made for keeping the excavation free from surface and seepage water during the jacking operation.

After the excavation is opened, the installation of the pipe shall follow immediately to avoid unnecessarily disturbing the stability of the embankment.

Backfilling shall be done in accordance with Article 2402.09. Surplus excavated material may be uniformly spread in the immediate vicinity of the work, as directed by the Engineer.

B. Accuracy of Placement.

When the location and grade line of the culvert have been determined by the position or elevation of the available outlet, insertion of the pipe shall be from the outlet end. When the location and grade have been determined by the position of the inlet and the elevation to which water must be lowered at the upstream end, insertion of the pipe shall be from the inlet end.

Install pipe at line and grade according to the following tolerances:

- a. Carrier pipe shall be installed at its true starting elevation and grade within a maximum alignment deviation of the pipe centerline as specified in the contract documents.
- b. When no deviation tolerances are specified in the contract documents, the following shall apply;
 - 1) Gravity Pipe: horizontal ± 1.0 foot per 100 feet (0.3 m per 30 m) of tunneling and vertical ± 0.2 feet up to 200 feet (0.06 m per 60 m) of tunneling. An additional ± 0.1 foot (0.03 m) between 200 feet and 300 feet (60 m and 90 m) or a total of ± 0.3 feet (0.09 m) deviation between 200 feet and 300 feet (60 m and 90 m).
 - 2) Pressure Pipe: horizontal ± 0.2 feet (0.06 m) and vertical ± 1.0 foot (0.3 m).
- c. The Contractor shall provide additional fittings, utility accesses, or appurtenances needed to accommodate any horizontal or vertical misalignment, if allowed by the Engineer, at no additional cost to the Contracting Authority.
- d. The Contractor will be allowed to correct errors in grade of a casing pipe in order to achieve design grade of the carrier pipe by pouring an invert in the casing pipe, or by

shimming the carrier pipe to a uniform grade, provided adequate clearance remains for proper installation of the carrier pipe.

Deviation from the prescribed line that reverses the fall of the grade line through the culvert shall be cause for rejection.

Openings more than 1/4 inch (5 mm) in width between adjacent sections of concrete pipe shall be filled with 1:2 cement/sand mortar.

Abandoned tunnels shall be filled with either a PCC 3,000 psi (21 MPa) mixture of approximately 4 inch (100 mm) slump or flowable mortar.

2418.04 METHOD OF MEASUREMENT.

The quantity of Pipe Installed by Trenchless Construction, of the size and type specified, in feet (meters), will be the quantity shown on the contract documents, for each pipe to the nearest foot (0.1 m), but not including aprons. The quantity of pipe will be determined along the axis.

Normal excavation for pipe installed by trenchless construction will not be measured for payment, but shall be considered incidental to the pipe installed. Excavation for boulders smaller than one-third the diameter of the pipe being installed, or parts of existing structures identified in the contract documents will not be measured for payment, but shall be considered incidental to the price bid for trenchless construction. Excavation and removal of boulders larger than one-third the diameter of the pipe being installed, or parts of existing structures not identified in the contract documents will be paid for in accordance with Article 1109.03, B.

2418.05 BASIS OF PAYMENT.

The Contractor will be paid the contract unit price for Pipe Installed by Trenchless Construction, of the type and size specified, per linear foot (meter). This payment shall be full compensation for equipment, labor, and materials to complete the work including sheeting, shoring, bracing, dewatering, pipe connections, excavation, and backfill. Installations that consist of both trenchless and conventionally placed pipe will include separate bid items for each portion.